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## PATENT ABSTRACTS OF JAPAN

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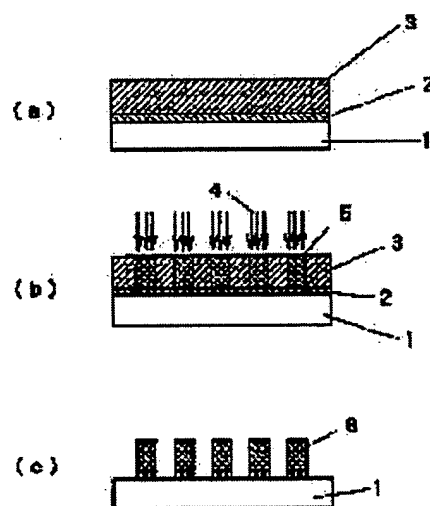
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## (54) RESIST PATTERN FORMING METHOD

(57)Abstract:

PURPOSE: To prevent under cutting phenomenon at the bottom of a resist and to form a resist pattern whose section is perpendicular.

CONSTITUTION: A first resist layer 2 giving a resist pattern having high crosslinking density and at least one second resist layer 3 giving a resist pattern having lower crosslinking density than the resist pattern given by the first resist layer 2 are formed on the surface of a substrate 1 and the resist layers are exposed to form a resist pattern. When a chemical amplification type resist is used as the resist, crosslinking density can be regulated by varying the concn. of an acid generating agent.



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CLAIMS

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[Claim(s)]

[Claim 1] The formation approach of the resist pattern characterized by exposing after forming at least one layer for the 2nd resist layer from which a resist pattern with crosslinking density smaller than the 1st resist layer is obtained after forming the 1st resist layer from which a resist pattern with big crosslinking density is obtained in a substrate side in the approach of forming a resist pattern on a substrate and preparing a multilayer resist layer on a substrate.

[Claim 2] The formation approach of the resist pattern according to claim 1 characterized by the 1st resist and 2nd resist being a chemistry magnification mold resist.

[Claim 3] The formation approach of the resist pattern according to claim 2 characterized by the concentration of the acid generator of the 1st resist being larger than the 2nd resist.

[Claim 4] The formation approach of the resist pattern according to claim 1 characterized by preparing the mixed prevention film which prevents mixing of both resists between the 1st resist layer and the 2nd resist layer.

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## DETAILED DESCRIPTION

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### [Detailed Description of the Invention]

[0001]

[Industrial Application] This invention relates to the formation approach of the resist pattern at the time of manufacturing large scale integration, such as LSI and a VLSI, a photo mask, etc., and relates to the approach of forming a detailed pattern in high degree of accuracy especially.

[0002]

[Description of the Prior Art] Semiconductor integrated circuits, such as IC, LSI, and a VLSI, are manufactured by repeating the so-called lithography processes, such as development and etching, after applying a resist on substrates, such as a silicone wafer, and exposing a desired pattern by a stepper etc. [0003] the place in which high integration of a semiconductor integrated circuit and high performance-ization remain -- the line breadth of not knowing and a pattern -- increasingly -- super- -- detailed-izing - it has high-degree-of-accuracy-ized. the line breadth of the resist pattern which will be formed if DRAM which is typical LSI is taken for an example -- by 1M bit, detailed-ization is required as 0.6 micrometers by 0.8 micrometers and 16M bit, and is increasingly demanded as 0.35 micrometers by 1.2 micrometers and 4M bit, 64M, and research of the exposure approach, a lithography process, a resist, etc. is done.

[0004] As a resist for forming a next-generation detailed pattern, the resist of a chemistry magnification mold is developed and it is used for manufacture of the latest device. If a common negative mold explains a chemistry magnification mold resist, by consisting of mixture of base resin like cresol novolak resin or polyvinyl phenol resin, a cross linking agent, and an acid generator, generating an acid by the exposure of ionizing radiation, such as light, and heating the generated acid as a catalyst, a cross linking agent will construct a bridge in base resin, and it will remove an unexposed part by development, and will form the resist pattern of a negative mold. This resist is an epoch-making resist which is satisfied with base resin like cresol novolak resin of the dry etching-proof nature which had secured high resolution in the alkali development of a non-swelling mold, respectively, and has been conventionally incompatible in high sensitivity with the chemical reaction according dry etching-proof nature to acid generating and heat bridge formation, high sensitivity, and all the high resolutions. And the various things i line as the exposure approach for next-generation device manufacture with this chemistry magnification type of leading resist, excimer laser, an electron ray, for X-rays, etc. are developed.

[0005]

[Problem(s) to be Solved by the Invention] However, although the detailed pattern of 0.3-micrometer level could form the above-mentioned chemistry magnification mold resist easily on substrates, such as a silicon wafer, it had the problem that the resist pattern with which the amount of [ of the resist pattern after development ] hem part has interlocking (necking) and a vertical cross-section configuration was not obtained, on the aluminum film, the SOG (Spin-on-glass) film, the chromium film, etc.

[0006] That is, although drawing 2 shows the formation approach of the resist pattern of the conventional chemistry magnification mold resist, as shown in drawing 2 (a), on a substrate 21, it applies a chemistry magnification mold resist to homogeneity with a spin coating method etc., performs

about [ a 5-60 minute room ] stoving processing at 60-200 degrees C, and forms the resist layer 22 with a thickness of about 0.3-2.0 micrometers. Next, as shown in drawing 2 (b), a photo mask is drawn an activity or directly and exposure 23 of a pattern is carried out to the resist layer 22 with an electron ray etc. Although a rinse is carried out and a resist pattern 25 is obtained after generating an acid into the exposure part 24 from an acid generator, advancing crosslinking reaction of the base resin of the resist which made the acid the catalyst with heating to it and developing negatives with a predetermined developer like drawing 2 (c) subsequently Interlocking 26 produces the resist pattern obtained in a part for a hem part. Cannot form a detailed resist pattern or When processing a substrate by using the formed resist pattern as a mask, there was a big problem that only inaccurate processing could be performed, and although it had as a resist the property which was excellent in versatility, enough resist patterns were not able to be formed.

[0007]

[Means for Solving the Problem] This invention is to be made in view of such a situation, prevent the necking phenomenon of a chemistry magnification mold resist effectively, and offer the approach of forming the detailed pattern of high degree of accuracy stably.

[0008] Namely, without changing the conventional lithography process substantially When it is the approach of using a chemistry magnification mold resist, being stabilized, a resist layer with the high concentration of an acid generator is formed in case a chemistry magnification mold resist thin film is formed on a substrate, and the concentration of an acid generator forms the usual resist layer on it Interlocking for a hem part (necking) is prevented, it is stabilized and the detailed pattern of high degree of accuracy without pattern omission etc. is formed.

[0009] Generating of an acid falls according to concentration distribution or the construction material of a substrate in the resist film, for this reason the crosslinking density in a substrate interface becomes low, and the acid generator which triggers crosslinking reaction is considered that an interlocking phenomenon arises in an interface with a substrate.

[0010] Then, this invention in order not to reduce the crosslinking density in an interface with the substrate of a resist By forming the 1st resist layer with the high concentration of an acid generator in a substrate side, and forming the 2nd resist layer of the usual acid generator concentration on it The crosslinking density in a substrate interface is raised, necking etc. is prevented, and adhesion makes the resist of the unstable chemistry magnification mold stably usable according to the class of substrate. Although the 1st resist can use the resist which adds an acid generator further to the resist which consists of mixture of base resin, a cross linking agent, and an acid generator, and which is usually used and by which the acid generator was beforehand blended with the 2nd resist as it is, it may adjust both the 1st resist and the 2nd resist by desired combination.

[0011] With reference to a drawing, the formation approach of the resist pattern of this invention is explained below. As shown in drawing 1 (a), on a substrate 1, the chemistry magnification mold resist (A) which contained many [ 10 to 50% ] acid generators rather than the usual resist is applied to homogeneity with a spin coating method etc., stoving processing is performed for 5 - 60 minutes at 60-200 degrees C, and the 1st resist layer 2 with a thickness of about 0.01-0.3 micrometers is formed. Then, on this, the usual chemistry magnification mold resist (B) is applied similarly, stoving processing is performed, and the 2nd resist layer 3 with a thickness of about 0.3-2.0 micrometers is formed.

Moreover, when the resist and compatibility of the 1st layer have the resist of a two-layer eye, it is desirable to prepare the thin film of the mixed prevention film which consists of matter in which solvents, such as polyvinyl alcohol, do not dissolve a resist between the 1st layer and a two-layer eye.

[0012] Next, as shown in drawing 1 (b), by ionizing radiation, such as an electron ray, through a photo mask, it draws directly and the resist layers 2 and 3 are carried out exposure 4. It heats after exposure and crosslinking reaction in the exposure part 5 is advanced, and negatives are continuously developed with a predetermined developer, and a rinse is carried out by the rinse, and if the resist pattern 6 as shown in drawing 1 (c) is formed, a resist pattern without the interlocking phenomenon for a hem part etc. will be formed.

[0013]

[Function] Concentration of the acid generator of the substrate side of a chemistry magnification mold resist layer can be made high, and the interlocking phenomenon for a hem part of a resist pattern, degradation of resolution, etc. can be prevented, and it becomes possible to be stabilized and to form the resist pattern of high degree of accuracy, without changing the conventional lithography process substantially.

[0014]

[Example] Below the example of this invention is shown and this invention is further explained to it at a detail.

On the photo-mask substrate of the two-layer structure which formed the chromium thin film of 800nm thickness, and the low reflective chromium thin film of 400nm thickness on the length by which example 1 chemical polishing was carried out, and a 125mm wide high grade synthetic quartz glass substrate, as an acid generator The chemistry magnification mold resist (product made from SHIPUREI SAL601) which added 1 and 1-BISUPARA chloro 2 and 2 and 2-trichloroethane 15% was applied with the spin coating method, it heat-treated at 90 degrees C for 30 minutes, and the uniform resist thin film with a thickness of 0.2 micrometers was obtained. The water solution of polyvinyl alcohol was applied to homogeneity by spin coating on this resist thin film, it heated for 10 minutes at 70 degrees C, and the film which consists of polyvinyl alcohol with a thickness of 50nm was formed.

[0015] Subsequently, on the thin film of polyvinyl alcohol, the chemistry magnification mold resist (product made from SHIPUREI SAL601) to which the acid generator is not made to increase exceptionally was applied with the spin coating method, it heat-treated at 90 degrees C for 30 minutes, and the uniform resist thin film with a thickness of 0.5 micrometers was formed.

[0016] The electron ray aligner performed pattern drawing for the obtained resist layer. The acceleration voltage at this time is 20kV, and light exposure is 10microC/cm<sup>2</sup>. It exposed. Then, after performing BEKU (PEB) after exposure for 5 minutes at 105 degrees C, negatives were developed in the alkali water solution which uses tetramethylammonium hydroxide as a principal component, the rinse was carried out with pure water, and the resist pattern was formed. The necking phenomenon in which the amount of [ of a resist ] hem part ate into the formed resist pattern was not seen, but it was good.

[0017] On the silicon wafer with a diameter of 150mm which formed example 2 aluminum, the chemistry magnification mold resist (product made from SHIPUREI SNR-248) which added the tribromomethyl allyl compound sulfone 25% as an acid generator was applied with the spin coating method, it heat-treated at 90 degrees C on the hot plate for 2 minutes, and the uniform resist thin film with a thickness of 0.15 micrometers was obtained. Then, the water solution of polyvinyl alcohol was applied to homogeneity by spin coating on this resist thin film, it heated for 1 minute at 70 degrees C on the hot plate, and the film which consists of polyvinyl alcohol with a thickness of 50nm was formed. Then, on this, the chemistry magnification mold resist (product made from SHIPUREI SNR-248) was applied with the spin coating method, on the hot plate, it heat-treated for 2 minutes at 100 degrees C, and the uniform resist thin film with a thickness of 1.0 micrometers was obtained.

[0018] Next, the acceleration voltage of 20kV and light exposure are 4microC/cm<sup>2</sup> by the electron ray aligner to the obtained resist layer. It exposed and pattern drawing was performed.

[0019] Subsequently, after carrying out BEKU processing after exposure for 60 seconds at 140 degrees C, negatives were developed in the alkali water solution which uses tetramethylammonium hydroxide as a principal component, the rinse was carried out with pure water, and the resist pattern was formed. As a result of observing the formed resist pattern with a scanning electron microscope, the pattern vertical to the substrate side which has the line breadth of 0.35 micrometers and spacing was formed.

[0020] On the length by which example of comparison 1 chemical polishing was carried out, and a 125mm wide high grade synthetic quartz glass substrate, the chemistry magnification mold resist (product made from SHIPUREI SAL601) was applied with the spin coating method on the photo-mask substrate which has two-layer structure of the chromium thin film of 800nm thickness, and the low reflective chromium thin film of 400nm thickness, it heat-treated at 90 degrees C for 30 minutes, and the uniform resist thin film with a thickness of 1.0 micrometers was obtained.

[0021] Next, the electron ray aligner performed pattern drawing to these substrates. The acceleration

voltage at this time is 20kV, and light exposure is 10microC/cm<sup>2</sup>. It exposed. Then, after performing BEKU after exposure for 5 minutes at 105 degrees C, negatives were developed in the alkali water solution used as a tetramethylammonium hydroxide principal component, the rinse was carried out with pure water, and the resist pattern was formed. When the cross section of the formed resist pattern was observed with the scanning electron microscope, the amount of [ of a resist pattern ] hem part is eating away, and exfoliation of a resist was also produced.

[0022]

[Effect of the Invention] By the formation approach of the resist pattern of this invention, by forming the high resist layer of crosslinking density in the side which touched the substrate side, and forming the resist layer of the usual crosslinking density on it, the interlocking phenomenon for the hem part of a resist is prevented, and it being stabilized and forming the resist pattern of high degree of accuracy can be realized, without changing the conventional lithography process substantially.

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DESCRIPTION OF DRAWINGS

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[Brief Description of the Drawings]

[Drawing 1] Drawing showing the formation process of the resist pattern of this invention.

[Drawing 2] Drawing showing the formation process of the conventional resist pattern.

[Description of Notations]

1 [ -- Exposure, 5 / -- An exposure part, 6 / -- A resist pattern, 21 / -- A substrate, 22 / -- A resist layer, 23 / -- Exposure, 24 / -- An exposure part, 25 / -- A resist pattern, 26 / -- Interlocking ] -- A substrate, 2 - The 1st resist layer, 3 -- The 2nd resist layer, 4

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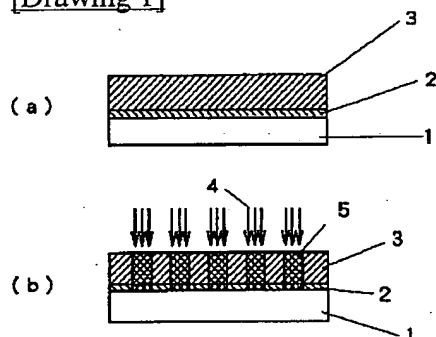
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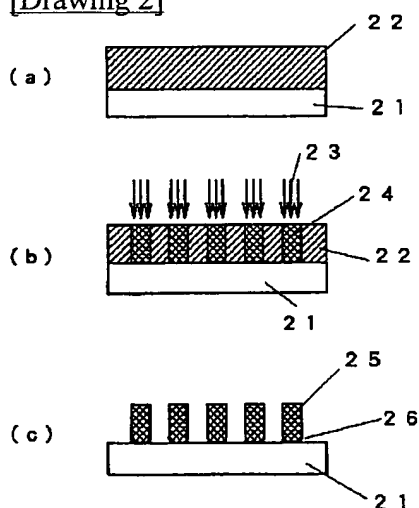
DRAWINGS

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[Drawing 1]



[Drawing 2]



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